Freshwater Mussel Communities of the Thames River, Ontario: 2004-2005.

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ABSTRACT

The Thames River was surveyed in 2004-2005 by Fisheries and Oceans Canada (DFO) to assess the status of mussel species at risk (SAR) in the river. Thirty-seven sites were sampled on the upper and lower Thames and a total of 6302 mussels were found representing 26 species. Four SAR were found alive, they are, from most to least abundant: *Quadrula quadrula* (Mapleleaf), *Villosa iris* (Rainbow), *Lampsilis fasciola* (Wavyrayed Lampmussel) and *Pleurobema sintoxia* (Round Pigtoe). *Truncilla donaciformis* (Fawnsfoot), a candidate species for listing by the Committee on the Status of Endangered Wildlife in Canada was also detected.

The presence/absence of the invasive *Dreissena polymorpha* (zebra mussel) was noted at each site sampled. This species was present in a stretch of the river from the Fanshawe Reservoir in London downstream to Thamesville, and is likely present down to the mouth of the Thames.

RÉSUMÉ

En 2004-2005, le ministère de Pêches et Océans Canada (MPO) a étudié la rivière Thames pour y évaluer l'état des espèces en péril (EP) (de moules). On a pris des échantillons de trente-sept sites, du haut et du bas de la Thames, et on a trouvé 6 302 moules au total, représentant 26 espèces. On a trouvé quatre EP vivantes, notamment, en ordre décroissant de population, le *Quadrula quadrula* (la mulette feuille d'érable), le *Villosa iris* (la villeuse irisée), la *Lampsilis fasciola* (la lampsile fasciolé) et le *Pleurobema sintoxia* (le pleurobème écarlate). On a également décelé la *Truncilla donaciformis*, qui fait partie des espèces candidates à la liste du Comité sur la situation des espèces en péril au Canada.

On a noté la présence/absence de la *Dreissena polymorpha*, espèce envahissante, à chacun des sites échantillonnés. Cette espèce était présente dans la partie de la rivière qui s'étend en aval du réservoir Fanshawe, à London, jusqu'à Thamesville : de toute probabilité, elle est présente jusqu'à l'embouchure de la Thames.

1.0 BACKGROUND

The Thames River originates northeast of London, Ontario, and flows for 273 km through southwestern Ontario to Lake St. Clair. The Thames is the second largest watershed in southwestern Ontario, draining 5285 km² of land (CHRS 2006). The upper portion of the river (known as the upper Thames River) consists of three distinct branches: 1) the North Thames River; 2) the Middle Thames River; and, 3) the South Thames River. The Middle Thames joins the South Thames east of London, while the North and South Thames join at the historic Fork of the Thames in the heart of London. From this point on, the river, known as the lower Thames River, flows southwest passing through Chatham and several more communities, including four First Nation Reserves, before it drains into Lake St. Clair at Lighthouse Cove (CHRS 2006).

The National Water Research Institute of Environment Canada has been compiling species occurrence records for freshwater mussels (unionids) from southern Ontario since 1996. Currently the database contains over 8000 records from more than 2000 sites dating back to 1860. Historically (before 1960) 32 species of mussels were found in the Thames River while sampling events after 1960 and up to 1995 detected only 26 species. A total of 400 records exist for the Thames River and the data show that mussel community in the river has experienced a continuous decline in species richness over time (Metcalfe-Smith *et al.* 1998b). The largest change in species composition occurred after 1988 and the mussel community has become increasingly dominated by the Anodontinae over the years. Members of the Anodontinae are thin-shelled mussels that are usually referred to as "floater" mussels. They can survive in soft, silty substrates and are considered to be tolerant of pollution (Metcalfe-Smith *et al.* 1998b). In 1994-1995, five of the eight most common species were Anodontinae which comprised 60% of the total records (Metcalfe-Smith *et al.* 1998b).

Nine species at risk (SAR) were historically or currently found in the Thames River: *Epioblasma triquetra* (Snuffbox); *Lampsilis fasciola* (Wavyrayed Lampmussel); *Obovaria subrotunda* (Round Hickorynut); *Pleurobema sintoxia* (Round Pigtoe); *Ptychobranchus fasciolaris* (Kidneyshell); *Quadrula quadrula* (Mapleleaf); *Simpsonaias ambigua* (Salamander Mussel); *Villosa fabalis* (Rayed Bean); and *V. iris* (Rainbow). All have been designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC), with the exception of *Q. quadrula* which has been

designated as Threatened. *E. triquetra* and *O. subrotunda* are believed to be extirpated from the Thames River, while *V. fabalis* was previously believed to be extirpated from the South Thames; however a new population was discovered in the North Thames in 2005 (TJM, unpublished data). *P. fasciolaris* was believed to be extirpated from the Thames until two specimens were found alive in Medway Creek in 2006. However, the specimens were very large, old individuals, and it is likely that *P. fasciolaris* is functionally extirpated.

2.0 CURRENT SURVEYS (2004-2005)

Twenty-seven sites were sampled in the upper Thames River in 2004 (25 sites) and 2005 (2 sites) and 10 sites were sampled in the lower Thames in 2005 (Figure 1). Surveys were conducted using an intensive timed-search technique developed for detecting rare species of mussels in rivers and is described in detail in Metcalfe-Smith *et al.* (2000). The riverbed is visually searched by a 3 person team using waders, polarized sunglasses and underwater viewers for a total of 4.5 person-hours (p-h) of sampling effort. Specimens are held alive until the end of the search period when they are identified, sexed (if possible), measured (shell length), counted and returned to the riverbed. If a larger search team is available, as was the case at some sites on the Thames, the amount of actual search time is reduced so that the total effort remains constant at 4.5 p-h. Locations of the 37 sites, dates surveyed, search effort used and members of the search team are presented in Table 1.

Dreissena polymorpha (zebra mussel) were first reported from the Thames River in 2003 (UTRCA 2003) when they were detected in Fanshawe and Springbank reservoirs by conservation authority staff. As these mussels are known to have catastrophic effects on native mussel populations (Nalepa 1996) the presence/absence of *D. polymorpha* was recorded at all sites surveyed.

2.1 SURVEY RESULTS

A total of 6302 live mussels representing 26 species were found (Table 2). Three species were represented by shells only (*O. subrotunda*, *P. fasciolaris* and *V. fabalis*) although additional work in 2005 as part of another project uncovered a live *V. fabalis* as well as a fresh shell in the North Thames River where they had not previously been known (TJM, unpublished data). All three species represented in this survey only by shells are Endangered. The eight most abundant species were *Actinonaias ligamentina*

(1580 individuals), *Lasmigona costata* (1068), *Elliptio dilatata* (677), *Quadrula pustulosa pustulosa* (671), *Pyganodon grandis* (534), *Q. quadrula* (427), *L. complanata complanata* (162), *Strophitus undulatus* (153) (Table 3). Species richness per site (live specimens only) ranged from 0 (sites TM04-17 and TM04-24) to 15 species (Site TM05-08) (Figure 2) and abundance ranged from 0 (sitesTM04-17 and TM04-24) to 671 (Site TM05-08) (Figure 3). Overall, patterns of species richness and abundance were highest in the lower river where the average total abundance was 313 animals and the average richness was 13 species. By comparison, in the upper river the average abundance was 126 animals and the average richness was only 5 species.

Dreissena polymorpha were detected at sites from the Fanshawe Reservoir in London, downstream to near Thamesville (Figure 4), and are likely present all the way to the mouth of the river. At sites where dreissenid mussels occurred they were observed on the substrate as well as attached to native unionids (Figure 5). They were not observed at sites upstream of the Fanshawe Reservoir on the North Thames or at any sites on the South or Middle Thames.

3.0 SIGNIFICANCE OF THE THAMES RIVER MUSSEL COMMUNITY

The Thames River has one of the most diverse freshwater mussel communities in Canada (only the Sydenham River has more species) (Cudmore *et al.* 2004). Of the eleven mussel SAR found in Ontario, nine were known to historically or currently inhabit the Thames River.

Of these nine SAR, four were detected during the surveys conducted in 2004-2005: *L. fasciola*, *P. sintoxia*, *Q. quadrula* and *V. iris*. *P. fasciolaris* and *V. fabalis* were not found alive during the 2004-2005 survey but have been found subsequently. One candidate species for COSEWIC designation, *Truncilla donaciformis* (Fawnsfoot), was also detected. *O. subrotunda*, *P. fasciolaris* and *V. fabalis* were not found alive during this survey; however, the shells of each were found at 1, 2 and 1 sites, respectively.

3.1 SPECIES AT RISK

3.1.1 *Lampsilis fasciola* (Wavyrayed Lampmussel) - Endangered

Lampsilis fasciola has been extirpated from its historical range in the western basin of Lake Erie, the majority of Lake St. Clair, the Detroit River and the Sydenham River. It is still extant in the Ausable and Grand rivers, although it's range has been

reduced in both. *L. fasciola* has recently been found for the first time in the Maitland River; however, population trends for the river cannot be determined as there are no historical data (Morris 2006). A small remnant population remains in the delta area of Lake St. Clair within the territory of the Walpole Island First Nation (Metcalfe-Smith and McGoldrick 2003).

There are only three historical records for *L. fasciola* in the Thames River (1902, 1931 and 1936). In 1997 and 1998 six large individuals were found, along with eight fresh shells and 14 weathered shells, at six sites in the upper Thames, North and Middle Thames rivers (TRRT 2005).

In 2004-2005, 48 live *L. fasciola* were found at 10 of 27 sites in the upper Thames while none were found at 10 sites on the lower Thames (Figure 6), for an overall relative abundance of 0.76% (Table 3). At sites where it was found, *L. fasciola* represented 0.44-33% of the total mussel community. The catch-per-unit-effort (CPUE) at sites on the upper Thames was 0.43 specimen/p-h and the overall CPUE for the upper and lower Thames was 0.29 specimens/p-h. There was a good representation of different size classes (Figure 7), suggesting a healthy reproducing population. *L. fasciola* was found along a 30 km stretch of the North Thames including Medway Creek and Fish Creek, a 25 km stretch of the South Thames from Dorchester to London and a small section of the Middle Thames from Thamesford to the confluence with the South Thames River (TRRT 2005). These data suggest that *L. fasciola* is much more abundant than previously thought, still occupies the full extent of its historic range in the Thames River (Morris 2006) and may, in fact, be expanding.

3.1.2 *Pleurobema sintoxia* (Round Pigtoe) - Endangered

Historically, *P. sintoxia* was found in lakes Erie and St. Clair, and the Detroit, Grand, Niagara, Sydenham and Thames rivers. The species is assumed to be extirpated from the offshore waters of lakes Erie and St. Clair, as well as the Detroit and Niagara rivers, due to the impacts of dreissenid mussels. Approximately 65% of sites where *P. sintoxia* was found historically are now infested with *D. polymorpha*. *P. sintoxia* is extant in the delta area of Lake St. Clair, and the Grand, Sydenham and Thames rivers. However, only the populations in the Lake St. Clair delta and Sydenham River are believed to be reproducing while populations in the Grand and Thames rivers are believed to be remnant (Morris and Burridge 2006). The Sydenham River is believed to

contain the healthiest population of round pigtoe in Ontario. Forty-five specimens were observed at seven different sites on the East Sydenham River and one site in the north branch and recruitment appears to be occurring, although only at one or two sites (COSEWIC 2004).

Six records of *P. sintoxia* exist for the Thames River between 1934 and 1995. Specimens and/or shells were collected at widely separated sites from Woodstock in the upper reaches to Chatham near the mouth (COSEWIC 2004). These data suggest that the Round Pigtoe was once broadly distributed, although likely still rare, in the Thames River. Although sixteen sites were sampled in 1997 and 1998, just two live specimens were found; both of which were very large and likely remnants of a dying population. Weathered shells were found at eight other sites over a 150 km reach, which further supports the idea the population was once larger and more widespread historically (COSEWIC 2004).

A total of 26 live specimens were found at two sites in the upper Thames River (Figure 8) during the 2004-2005 survey. *P. sintoxia* represented 0.41% of the total mussel community (Table 3) and the CPUE was 0.16 specimens/p-h. No live *P. sintoxia* were found during the 2005 survey of the lower Thames, although shells were found at one site. Shell lengths were skewed towards larger, older animals, suggesting a reduction or failure in recruitment (Figure 9). *P. sintoxia* are currently restricted to a very small area in the upper reaches of the Middle and South Thames rivers between Thamesford and London.

3.1.3 *Quadrula quadrula* (Mapleleaf) - Threatened

Quadrula quadrula has been lost from approximately 49% of its former range in Ontario, with almost all of this loss occurring in the Great Lakes and their connecting channels as a result of the impacts of dreissenid mussels. Aside from the Thames River, *Q. quadrula* is currently found in the Ausable, Grand and Sydenham rivers.

Q. quadrula has been reported from several locations in the middle and lower reaches of the Thames in 1894, 1934, 1963, 1973, 1985, and 1991-92. A survey was conducted in 1994 focusing on smaller tributaries of the Thames and found *Q. quadrula* at one site (30 sites sampled) on McGregor Creek in Chatham (Morris 1996). Sixteen sites were sampled on the main stem of the river in 1997-1998 and *Q. quadrula* was

located at seven sites in the lower part of the watershed (Metcalfe-Smith *et al.* 1998a, 1999).

In 2004-2005 *Q. quadrula* was the 6th most common species collected, representing 6.77% of the mussels found. At sites where it was found, *Q. quadrula* ranged from 1.7-22.8% of the total mussel community. It was present at 10 of 37 sites sampled, all of which were located in the lower Thames (Figure 10). Shell lengths were normally distributed, indicating successful reproduction and recruitment (Figure 11). A total of 427 live *Q. quadrula* were found after 166.5 p-h of search effort for a CPUE of 2.56 specimens/p-h. However, *Q. quadrula* occurs mainly in the lower reaches of medium- to large-sized rivers and sites in 2004 were located in the upper Thames. If CPUE is determined using only those data from sites in the occupied reach of the river (i.e. the lower Thames) then the CPUE becomes 7.9 specimens/p-h. This is over two and a half times the CPUE reported in previous surveys. Based on the CPUE values using only those data from sites in occupied reaches, the lower Thames contains the largest population of *Q. quadrula* in Ontario, followed by the Grand River (6.9 specimens/p-h), Sydenham (2.0) and Ausable (1.0) (COSEWIC 2006a).

3.1.4 *Villosa iris* (Rainbow) - Endangered

Villosa iris was historically found in lakes Erie, Huron, Ontario and St. Clair as well as the Ausable, Bayfield, Detroit, Grand, Maitland, Moira, Niagara, Salmon, Saugeen, Sydenham, Thames and Trent rivers. It has been lost from Lake Erie and much of Lake St. Clair, as well as the Detroit and Niagara rivers due to infestations of dreissenid mussels. Almost 50% of the sites where *V. iris* was historically known to occur are now infested with *D. polymorpha* (COSEWIC 2006b). Populations remain extant in the delta area of Lake St. Clair and the Ausable, Grand, Maitland, Moira, Saugeen, Sydenham and Thames rivers. The population in the delta of Lake St. Clair is estimated to be 7200 individuals; however, it is declining at an estimated rate of 7% per year (COSEWIC 2006b). *V. iris* populations in the Ausable, Grand, Saugeen and Sydenham rivers are very small, with only 20 individuals collected from 148 sites over the past 10 years (COSEWIC 2006b). The East Sydenham River has an estimated population of 18 900 individuals which is believed to be in decline (COSEWIC 2006b). The CPUE for *V. iris* in the Maitland River is 10 to 100 times higher than any other waterbody and it is believed to support the largest and healthiest population in Canada.

A total of 96 live specimens were collected from seven sites in the upper and lower Thames during the 2004-2005 surveys (Figure 12). The species had a relative abundance of 1.52% and a CPUE of 0.58 specimens/p-h. All specimens observed in 2004-2005 were collected from the upper Thames River. At sites where it was found, *V. iris* represented 0.60-26% of the total mussel community. The size frequency distribution was normally distributed, indicating a healthy, reproducing population (Figure 13). Currently, *V. iris* inhabits several tributaries of the North Thames River and a small reach of the Middle Thames River.

3.1.5 *Truncilla donaciformis* (Fawnsfoot) – COSEWIC Candidate Species

Truncilla donaciformis was known historically from the lower Great Lakes drainage of southern Ontario including Lake Erie and Lake St. Clair, as well as the Detroit and Niagara rivers and was recently recorded (2005) for the first time in the Saugeen River of the lower Lake Huron drainage. Only 58 records exist for this species in Canada, dating back to 1930 when it was detected for the first time in the western basin of Lake Erie. It has been extirpated from Lake Erie and the Detroit and Niagara rivers as a result of dreissenid mussel infestations, and is currently found in the Lake St. Clair delta, lower Grand River, Saugeen River (Muskrat Creek), lower Sydenham River, lower Thames River and the lower Welland River (Lyons Creek). Records of *T. donaciformis* from Muskrat Creek and Lyons Creek consist only of single animals collected on a single occasion. The only record of the species from Lake St. Clair in the last 15 years was a single live animal collected from the delta area in 2003. Recent records for the lower Grand River consist of 11 live animals found in 1997-1998. In the Sydenham River, *T. donaciformis* has only been detected from one site in low numbers.

There are no historical records of *T. donaciformis* in the Thames River; the first record for the species in this watershed was in 1997. In 2004-2005, *T. donaciformis* comprised 0.30% of the mussel community in the Thames. Sampling yielded 19 live specimens from four sites (Figure 14), all on the lower Thames, for a CPUE of 0.11 specimens/p-h. At sites where *T. donaciformis* was found it ranged from 0.15-4.0% of the total mussel community. Although the sample size was small, there was a range of size classes which is indicative of successful reproduction (Figure 15). Between 1997, when the first *T. donaciformis* record was found, to 2005, a total of 48 unique sites have been sampled in the Thames River, for a total of 216 p-h of effort. A total of 23 live *T.*

donaciformis were found at seven sites in the lower Thames along a 112 km stretch between London and Chatham. The Thames River likely contains the largest and healthiest remaining population of *T. donaciformis* in Canada.

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Table 1. Locations of sites surveyed for mussels in the Thames River in 2004 and 2005, dates surveyed, search effort and search team.

Site Number	Date	Latitude	Longitude	Waterbody	Local Description	Effort (person-hours)	Collector(s)
TM04-1	07/05/2004	43.0419	-81.1931	North Thames	Fanshawe Dam	4.5	Morris, Foester, Allard
TM04-2	07/05/2004	43.0972	-81.169	North Thames	Rebecca Rd and Thorndale	4.5	Morris, Allard, Foester
TM04-3	07/06/2004	43.2399	-81.1871	North Thames	South of Ramoch	4.5	Morris, Allard, Foester
TM04-4	07/06/2004	43.3238	-81.1787	North Thames	n/a	4.5	Morris, Foester, Allard
TM04-5	07/06/2004	43.4101	-81.2154	North Thames	n/a	4.5	Morris, Allard, Foester
TM04-6	07/08/2004	42.992	-81.9876	South Thames	n/a	4.5	Morris, Allard, Foester, VanNess
TM04-7	07/08/2004	42.9714	-81.1828	South Thames	Meadowlily Nature Preserve	4.5	Morris, Foester, Allard, VanNess
TM04-8	07/09/2004	42.9324	-81.4241	Thames	Little Komoka Island	4.5	Morris, Foester, Allard, VanNess
TM04-9	07/09/2004	42.9118	-81.4241	Thames	Delaware Conservation Area	4.5	Morris, Foester, Allard, VanNess
TM04-10	07/12/2004	43.2093	-81.2067	North Thames	Elginfield Rd. and Line 1 Blanshard River Valley Golf Resort	4.5	Morris, Allard, Foester, Welch
TM04-11	07/12/2004	43.2163	-81.2207	Fish Creek	Fish Ck and confluence with North Thames -- Elginfield and Line Q	4.5	Morris, Allard, Foester, Welch
TM04-12	13/07/2004	43.2279	-81.2571	Fish Creek	Whalen Rd, UTRCA Property	4.5	Morris, Foester, Allard
TM04-13	13/07/2004	43.287	-81.1156	Otter Creek	n/a	4.5	Morris, Foester, Allard
TM04-14	14/07/2004	43.0475	-81.1119	Waubuno Creek	Heritage Rd., UTRCA site	4.5	Morris, Foester, Allard
TM04-15	14/07/2004	43.2045	-80.914	North Branch Creek	Downstream of Thamesford	4.5	Morris, Allard, Foester
TM04-16	14/07/2004	43.0459	-80.9969	Middle Thames	North of Embro	4.5	Morris, Allard, Foester
TM04-17	15/07/2004	43.0406	-81.1935	North Thames	Clarke Rd @ CA office	4.5	Morris, Foester, VanNess
TM04-18	15/07/2004	43.0881	-81.3058	Medway Creek	10 Mile Rd. between Adelaide and Richmond	4.5	Morris, Foester, VanNess
TM04-19	15/07/2004	43.1794	-81.1951	North Thames	Dead end road	4.5	Morris, Foester, VanNess
TM04-20	16/07/2004	42.9747	-81.2333	South Thames	Watson Pk., off Wellington	4.5	Morris, Allard, Foester, Melissa
TM04-21	16/07/2004	43.0116	-81.2705	Medway Creek	Richmond St. bridge @ Westminster College	4.5	Morris, Foester, Allard, Evans
TM04-22	19/07/2004	43.2371	-80.7072	South Thames	Upstream of Innerkip, UTRCA mussel site	4.5	Morris, Allard, Foester, VanNess
TM04-23	19/07/2004	43.2583	-80.7398	South Thames	Rd. 8	4.5	Morris, Allard, Foester, VanNess
TM04-24	20/07/2004	43.4524	-81.1823	Whirl Creek	#23 outside Mitchell	4.5	Morris, Foester, Allard
TM04-25	20/07/2004	43.319	-81.1476	Avon River	n/a	4.5	Morris, Allard, Foester
TM05-01	16/08/2005	42.64275	-81.70346	Thames River	Big Bend CA	4.5	Morris, Staton, Cudmore
TM05-02	17/08/2005	42.66115	-81.70898	Thames River	ESD site TR16, upstream of Big Bend, boat access	4.5	Morris, Staton, Stackhouse
TM05-03	23/08/2005	42.80924	-81.42523	Thames River	FN site, upstream of Jubilee Creek, boat access	4.5	Morris, Barnucz, Stackhouse, Martens, Maness
TM05-04	23/08/2005	42.8001	-81.42448	Thames River	FN site, 3.35km downstream of Muncey Bridge, boat access	4.5	Morris, Barnucz, Stackhouse, Martens, Maness
TM05-05	24/08/2005	42.78228	-81.42682	Thames River	FN site, 800m downstream of cemetery access point, boat access	4.5	Morris, Barnucz, Stackhouse, Martens, Maness
TM05-06	13/09/2005	42.38945	-82.10917	McGregor Creek	Morris 96 site	4.5	Morris, Barnucz, Leisti, Wilson
TM05-07	14/09/2005	42.66107941	-81.7374496	Thames River	ESD site TR15, near Wardsville, boat access	4.5	Morris, Barnucz, Leisti, Wilson
TM05-08	14/09/2005	42.65609	-81.72509	Thames River	midway between Big Bend and TM05-07	4.5	Morris, Barnucz, Leisti, Wilson
TM05-09	15/09/2005	42.56367052	-81.9298268	Thames River	UTRCA site @ Tecumseh Monument on highway 2	4.5	Morris, Barnucz, Leisti
TM05-10	15/09/2005	42.70901871	-81.6158761	Thames River	ESD site TR01, Tate's Bridge	4.5	Morris, Barnucz, Leisti
TM05-11	07/10/2005	43.02066	-81.30506	Medway Creek	At Fanshawe Park Rd	4.5	Morris, Schwindt, Wilson, Gillingwater, Hindmarsh, Killins, Bryan, Piraino
TM05-12	07/10/2005	43.32625	-81.31145	Fish Creek	Hwy 23 in Kirkton	4.5	Morris, Schwindt, Wilson, Gillingwater, Hindmarsh, Killins, Bryan, Piraino

Table 2. Numbers of live specimens of each species observed at all survey sites in the Thames River watershed in 2004 and 2005. Species represented by shells only are indicated as "SH".

Common Name	Species	TM04-1	TM04-2	TM04-3	TM04-4	TM04-5	TM04-6	TM04-7	TM04-8	TM04-9	TM04-10	TM04-11	TM04-12
mucket	*Actinonaias ligamentina*		1	1			6	6	14	208		6	
elktoe	*Alasmidonta marginata*		5	4	1		SH	SH	10	8	12	2	2
slippershell	*Alasmidonta viridis*				SH*								
threeridge	*Amblema plicata plicata*								3	12			
cylindrical papershell	*Anodontoides ferussacianus*												
purple wartyback	*Cyclonaias tuberculata*		9					SH					
spike	*Elliptio dilatata*		2	SH	SH	SH	SH	SH			SH	124	99
Wabash pigtoe	*Fusconaia flava*						5	1					
plain pocketbook	*Lampsilis cardium*		2				4		7	13	2	1	
wavyrayed lampmussel	*Lampsilis fasciola*		9	1	1		SH	SH			15	1	2
fatmucket	*Lampsilis siliquoidea*												2
white heelsplitter	*Lasmigona complanata complanata*	1						4	8	4			
creek heelsplitter	*Lasmigona compressa*						SH				2		
flutedshell	*Lasmigona costata*	8	36	29	SH	SH	80	15	53	121	107	82	46
fragile papershell	*Leptodea fragilis*		1						1	4			
black sandshell	*Ligumia recta*								SH	8			
threehorn wartyback	*Obliquaria reflexa*												
round hickorynut	*Obovaria subrotunda*												
round pigtoe	*Pleurobema sintoxia*						SH	SH					
pink heelsplitter	*Potamilus alatus*								SH	2			
kidneyshell	*Ptychobranchus fasciolaris*												
giant floater	*Pyganodon grandis*					3						5	18
pimpleback	*Quadrula pustulosa pustulosa*									4			
mapleleaf	*Quadrula quadrula*												
creeper	*Strophitus undulatus*	3	1	1	1			SH			12	3	1
fawnsfoot	*Truncilla donaciformis*												
deertoe	*Truncilla truncata*								7	4			
rayed bean	*Villosa fabalis*		SH										
rainbow	*Villosa iris*				SH	SH						2	4
	Count	**12**	**66**	**36**	**3**	**3**	**95**	**26**	**103**	**388**	**150**	**226**	**174**
	Diversity (live only)	**3**	**9**	**5**	**3**	**1**	**4**	**4**	**8**	**11**	**6**	**9**	**8**
	Diversity (live and dead)	**3**	**10**	**6**	**7**	**4**	**9**	**10**	**10**	**11**	**7**	**9**	**8**

*possible *A. viridis*

Table 2 (Con't). Numbers of live specimens of each species observed at all survey sites in the Thames River watershed in 2004 and 2005. Species represented by shells only are indicated as "SH".

Common Name	Species	TM04-13	TM04-14	TM04-15	TM04-16	TM04-17	TM04-18	TM04-19	TM04-20	TM04-21	TM04-22	TM04-23	TM04-24	TM04-25
mucket	*Actinonaias ligamentina*			6					38	1				
elktoe	*Alasmidonta marginata*			3				15	1	3				
slippershell	*Alasmidonta viridis*	SH	SH	SH	1						SH	SH	SH	
threeridge	*Amblema plicata plicata*													
cylindrical papershell	*Anodontoides ferussacianus*				22		4				5	1		
purple wartyback	*Cyclonaias tuberculata*								SH					
spike	*Elliptio dilatata*	120	SH	280	2		13	2		SH	6		SH	
Wabash pigtoe	*Fusconaia flava*		1	4					1		2			
plain pocketbook	*Lampsilis cardium*													
wavyrayed lampmussel	*Lampsilis fasciola*			8				9	1	1				
fatmucket	*Lampsilis siliquoidea*										28	70		
white heelsplitter	*Lasmigona complanata complanata*								64					
creek heelsplitter	*Lasmigona compressa*				11				2		5	3		
flutedshell	*Lasmigona costata*	9		146				46	70	30	24	18		1
fragile papershell	*Leptodea fragilis*													
black sandshell	*Ligumia recta*													
threehorn wartyback	*Obliquaria reflexa*													
round hickorynut	*Obovaria subrotunda*													
round pigtoe	*Pleurobema sintoxia*			25					1					
pink heelsplitter	*Potamilus alatus*													
kidneyshell	*Ptychobranchus fasciolaris*													
giant floater	*Pyganodon grandis*	23	11		159	SH	150			14	75	5	SH	SH
pimpleback	*Quadrula pustulosa pustulosa*													
mapleleaf	*Quadrula quadrula*													
creeper	*Strophitus undulatus*	5	4	36				2		46	19	11		SH
fawnsfoot	*Truncilla donaciformis*													
deertoe	*Truncilla truncata*													
rayed bean	*Villosa fabalis*													
rainbow	*Villosa iris*	55		14			1		SH		1			
	Count	**212**	**16**	**522**	**195**	**0**	**168**	**74**	**178**	**95**	**165**	**108**	**0**	**1**
	Diversity (live only)	**5**	**3**	**9**	**5**	**0**	**4**	**5**	**8**	**6**	**9**	**6**	**0**	**1**
	Diversity (live and dead)	**6**	**5**	**10**	**5**	**1**	**4**	**5**	**10**	**7**	**10**	**7**	**3**	**3**

Table 2 (Con't). Numbers of live specimens of each species observed at all survey sites in the Thames River watershed in 2004 and 2005. Species represented by shells only are indicated as "SH".

Common Name	Species	TM05-01	TM05-02	TM05-03	TM05-04	TM05-05	TM05-06	TM05-07	TM05-08	TM05-09	TM05-10	TM05-11	TM05-12	Total
mucket	*Actinonaias ligamentina*	120	71	187	84	128		24	309	51	308	11		**1580**
elktoe	*Alasmidonta marginata*	1	1	1	3	SH		2	4	12	15	1		**106**
slippershell	*Alasmidonta viridis*													**1**
threeridge	*Amblema plicata plicata*	1	1	2	1	1	13	1	14	2	3			**54**
cylindrical papershell	*Anodontoides ferussacianus*													**32**
purple wartyback	*Cyclonaias tuberculata*	8	1	3	4			1	21	12	9			**68**
spike	*Elliptio dilatata*				SH							29	SH	**677**
Wabash pigtoe	*Fusconaia flava*						15					9		**38**
plain pocketbook	*Lampsilis cardium*	6	1	12	3	11		2	10					**74**
wavyrayed lampmussel	*Lampsilis fasciola*													**48**
fatmucket	*Lampsilis siliquoidea*						1							**101**
white heelsplitter	*Lasmigona complanata complanata*	11	4	6	3	2	18	11	9	11	6			**162**
creek heelsplitter	*Lasmigona compressa*				1		14				1			**39**
flutedshell	*Lasmigona costata*	1	7	9	7	4		4	16	31	41	27		**1068**
fragile papershell	*Leptodea fragilis*	12	19	4	2	3	7	17	26	24	16			**136**
black sandshell	*Ligumia recta*	1	1	4		2			2		2			**20**
threehorn wartyback	*Obliquaria reflexa*	4	SH			1			2	3	4			**14**
round hickorynut	*Obovaria subrotunda*				SH									**0**
round pigtoe	*Pleurobema sintoxia*				SH									**26**
pink heelsplitter	*Potamilus alatus*	2	4	3			SH	5	9	5	5			**35**
kidneyshell	*Ptychobranchus fasciolaris*	SH						SH						**0**
giant floater	*Pyganodon grandis*						19	SH				SH	52	**534**
pimpleback	*Quadrula pustulosa pustulosa*	164	27	36	28	15	1	86	142	115	53			**671**
mapleleaf	*Quadrula quadrula*	70	41	19	22	3	3	23	100	22	124			**427**
creeper	*Strophitus undulatus*						4					3	1	**153**
fawnsfoot	*Truncilla donaciformis*	SH	SH	SH	3			1	1	14				**19**
deertoe	*Truncilla truncata*	8	2	4	3	2		3	6	45	39			**123**
rayed bean	*Villosa fabalis*													**0**
rainbow	*Villosa iris*												19	**96**
	Count	**409**	**180**	**290**	**164**	**172**	**95**	**180**	**671**	**347**	**626**	**80**	**72**	**6302**
	Diversity (live only)	**14**	**13**	**13**	**13**	**11**	**10**	**13**	**15**	**13**	**14**	**6**	**3**	**26**
	Diversity (live and dead)	**16**	**15**	**14**	**16**	**12**	**11**	**15**	**15**	**13**	**14**	**7**	**4**	**29**

Table 3. Composition of the mussel community of the Thames River.

Species	Abundance	Relative Abundance (%)	Frequency of Occurrence (%)
Actinonaias ligamentina	1580	25.07	54.05
Lasmigona costata	1068	16.95	75.68
Elliptio dilatata	677	10.74	27.03
Quadrula pustulosa pustulosa	671	10.65	29.73
Pyganodon grandis	534	8.47	32.43
Quadrula quadrula	427	6.77	27.03
Lasmigona complanata complanata	162	2.57	40.54
Strophitus undulatus	153	2.43	45.94
Leptodea fragilis	136	2.16	35.13
Truncilla truncata	123	1.95	29.73
Alasmidonta marginata	106	1.68	56.76
Lampsilis siliquoidea	101	1.60	10.81
Villosa iris	96	1.52	18.92
Lampsilis cardium	74	1.17	35.13
Cyclonaias tuberculata	68	1.08	24.32
Amblema plicata plicata	54	0.86	32.43
Lampsilis fasciola	48	0.76	27.03
Lasmigona compressa	39	0.62	21.62
Fusconaia flava	38	0.60	21.62
Potamilus alatus	35	0.55	21.62
Anodontoides ferussacianus	32	0.51	10.81
Pleurobema sintoxia	26	0.41	5.40
Ligumia recta	20	0.32	18.92
Truncilla donaciformis	19	0.30	10.81
Obliquaria reflexa	14	0.22	13.51
Alasmidonta viridis	1	0.016	2.70

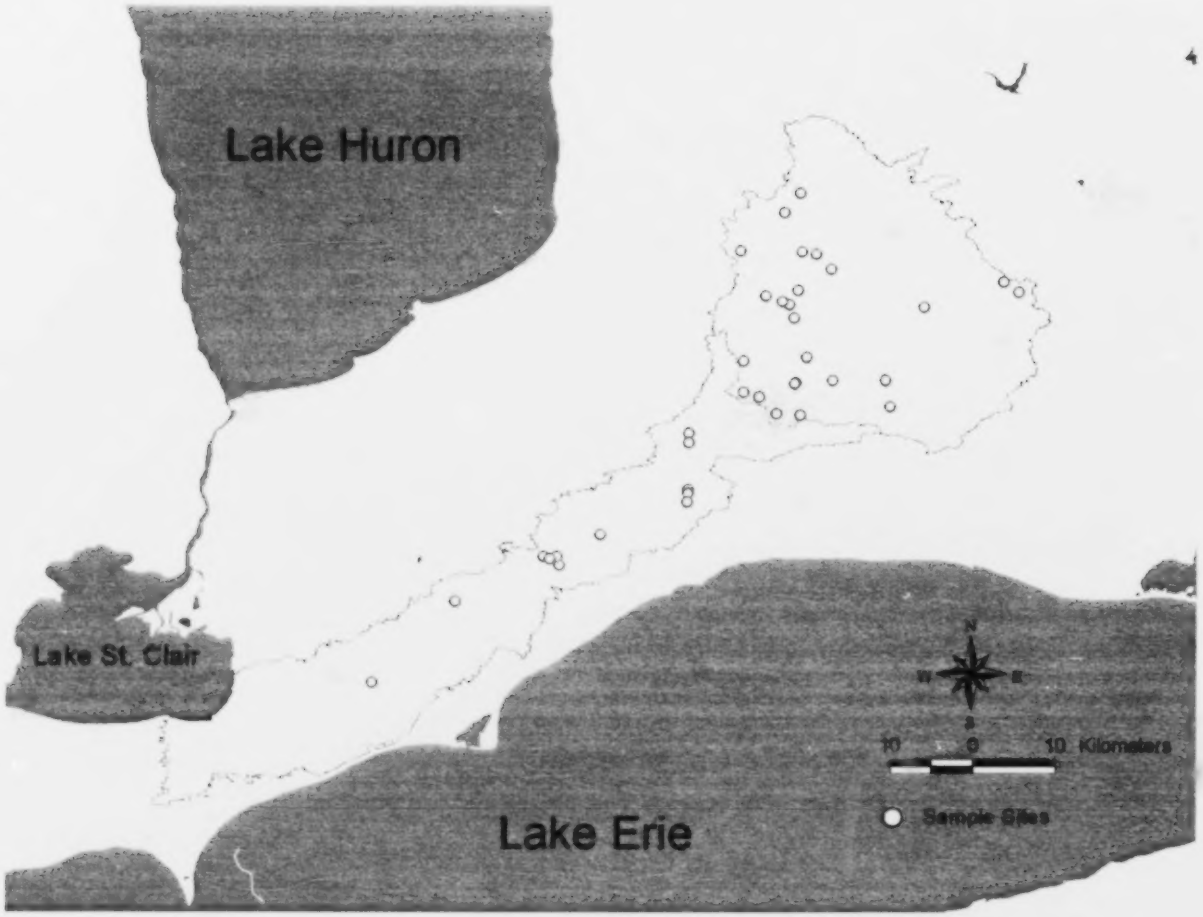

Figure 1. All sites sampled on the Thames River in 2004 (upper Thames) and 2005 (lower Thames).

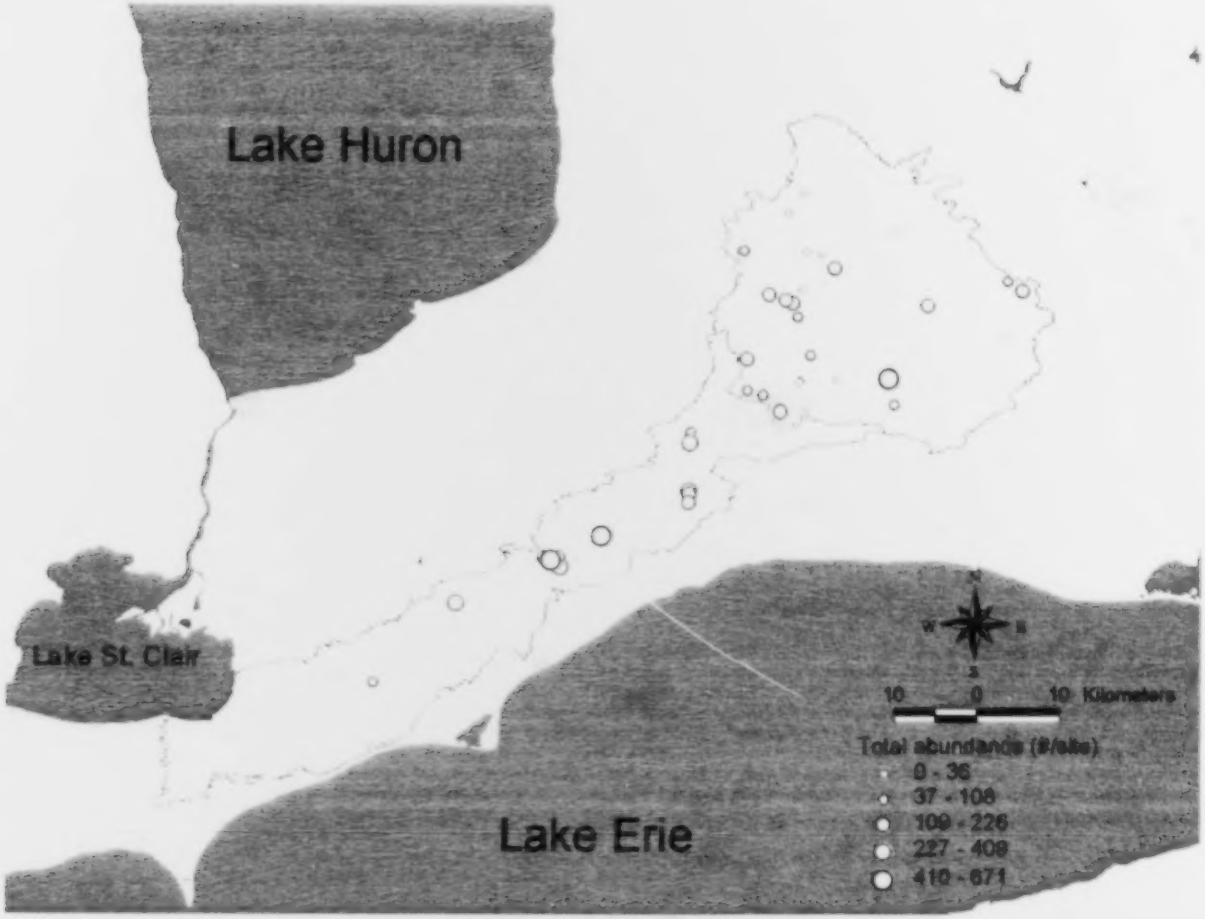

Figure 2. Total abundance (# of mussels/site) for 2004-2005 Thames River sampling.

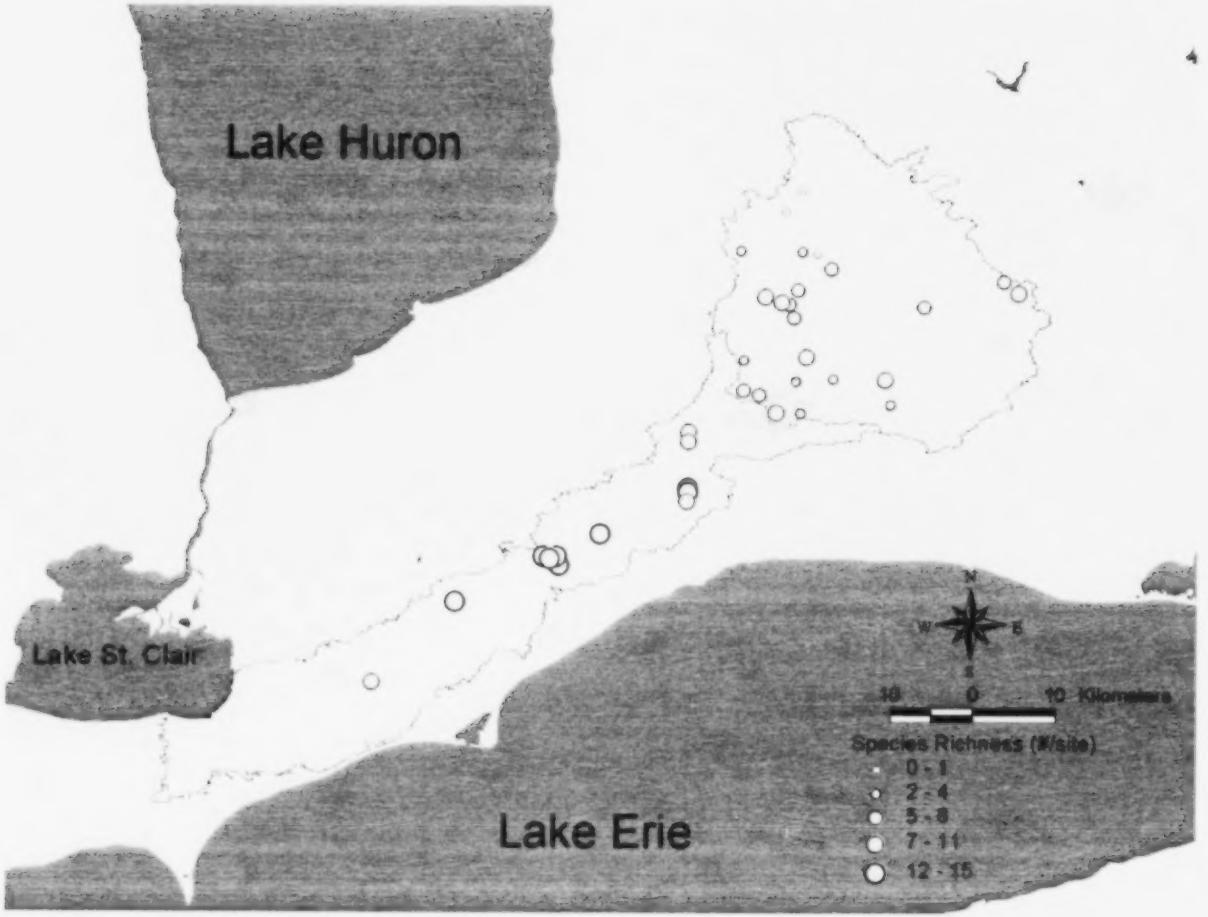

Figure 3. Species richness (# of species/site) at sites surveyed on the Thames River in 2004-2005.

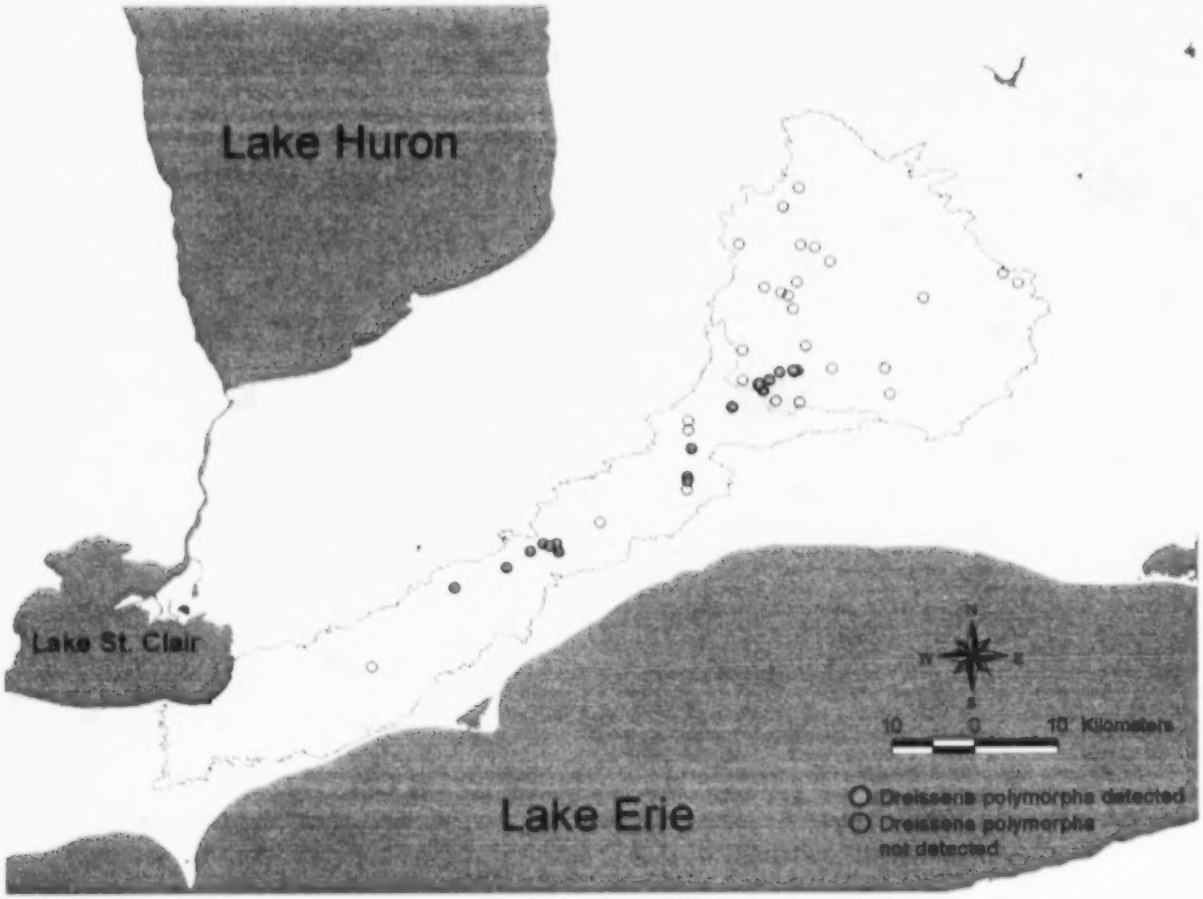

Figure 4. Sites where *Dreissena polymorpha* were detected during the 2004-2005 Thames River survey.

Figure 5. *Dreissena polymorpha* attached to native unionids in the Thames River: left - *Lampsilis cardium* at TM05-01; right - *Lasmigona costata* at TM04-01.

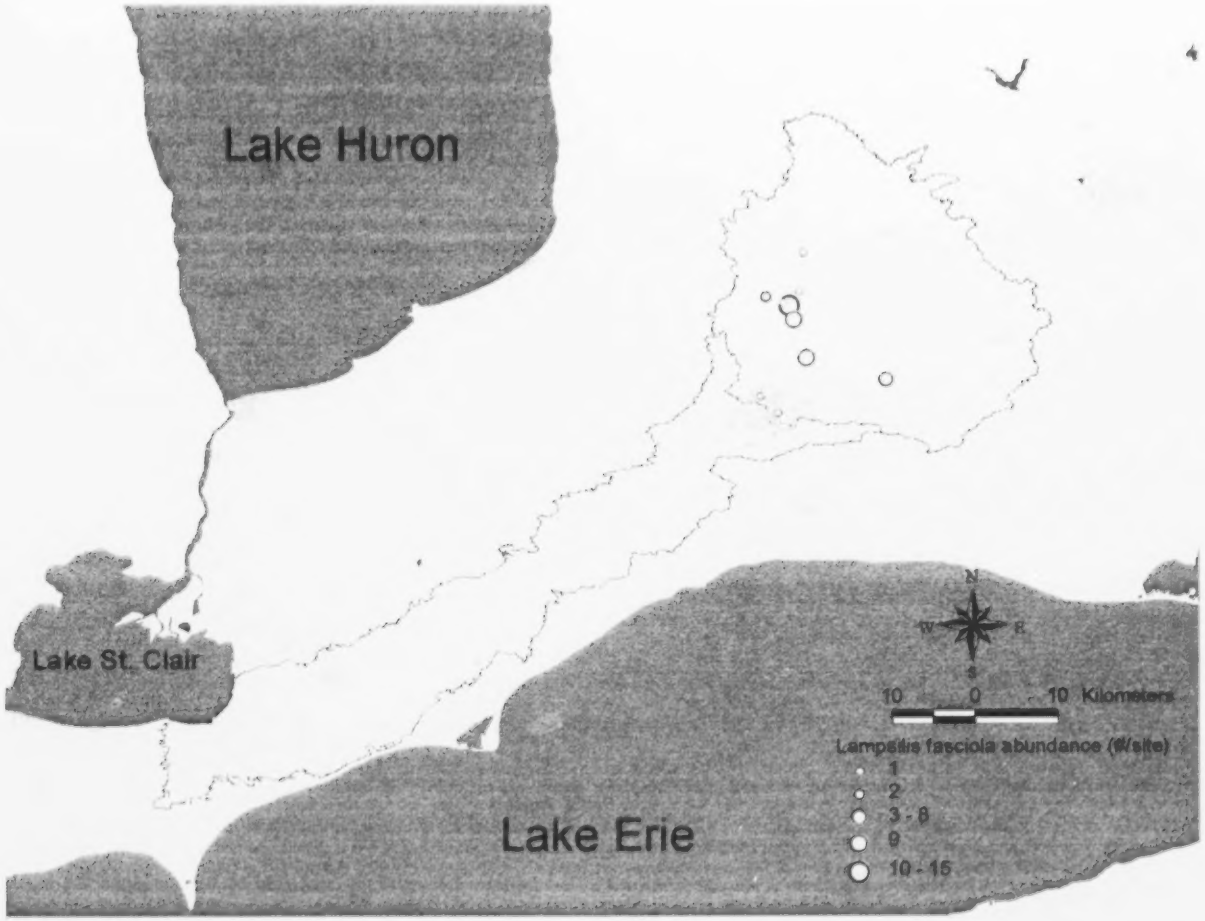

Figure 6. *Lampsilis fasciola* abundance at 2004-2005 Thames River sites.

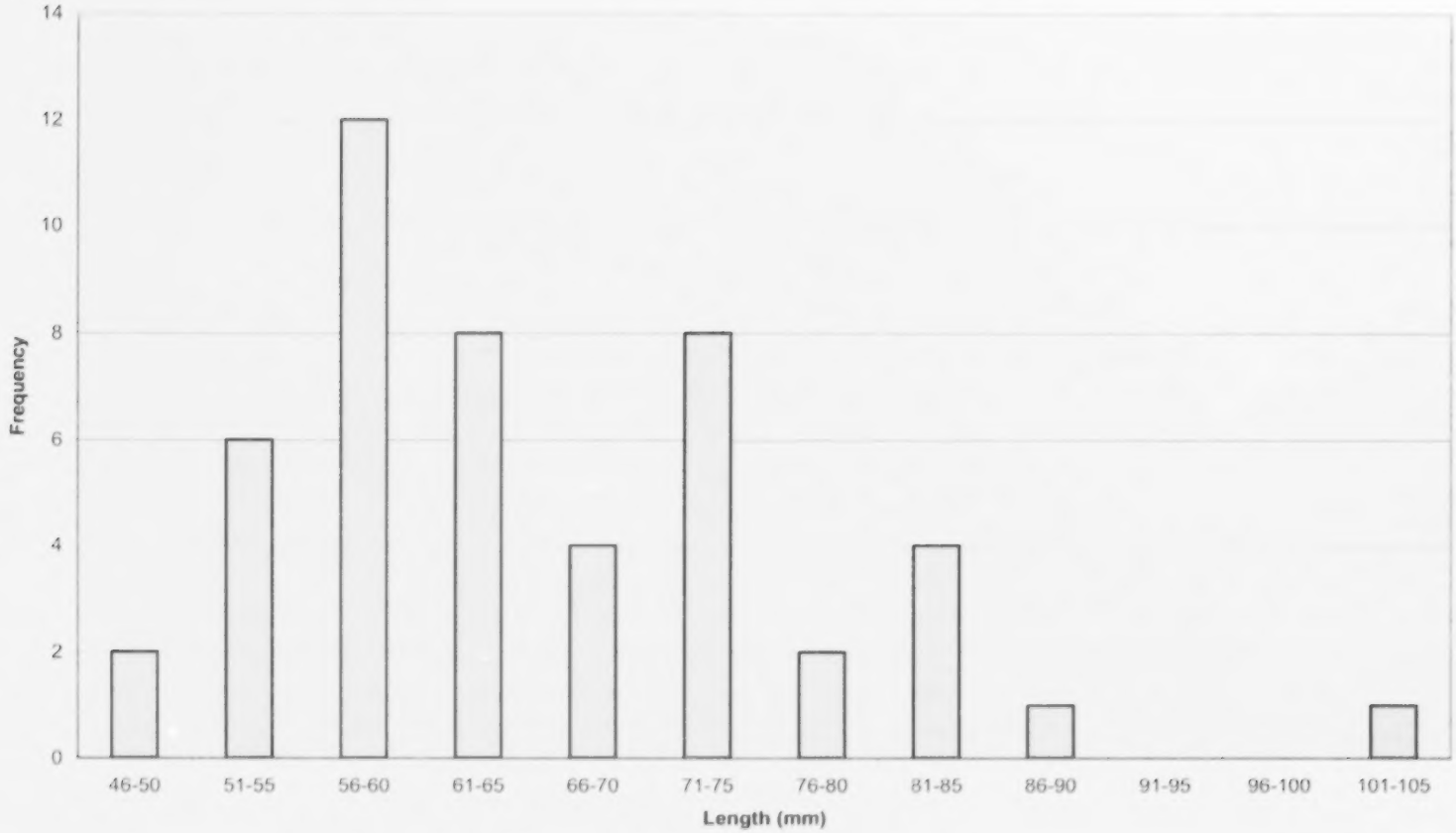

Figure 7. Size distribution of *Lampsilis fasciola* collected from the Thames River using timed-search methods in 2004-2005.

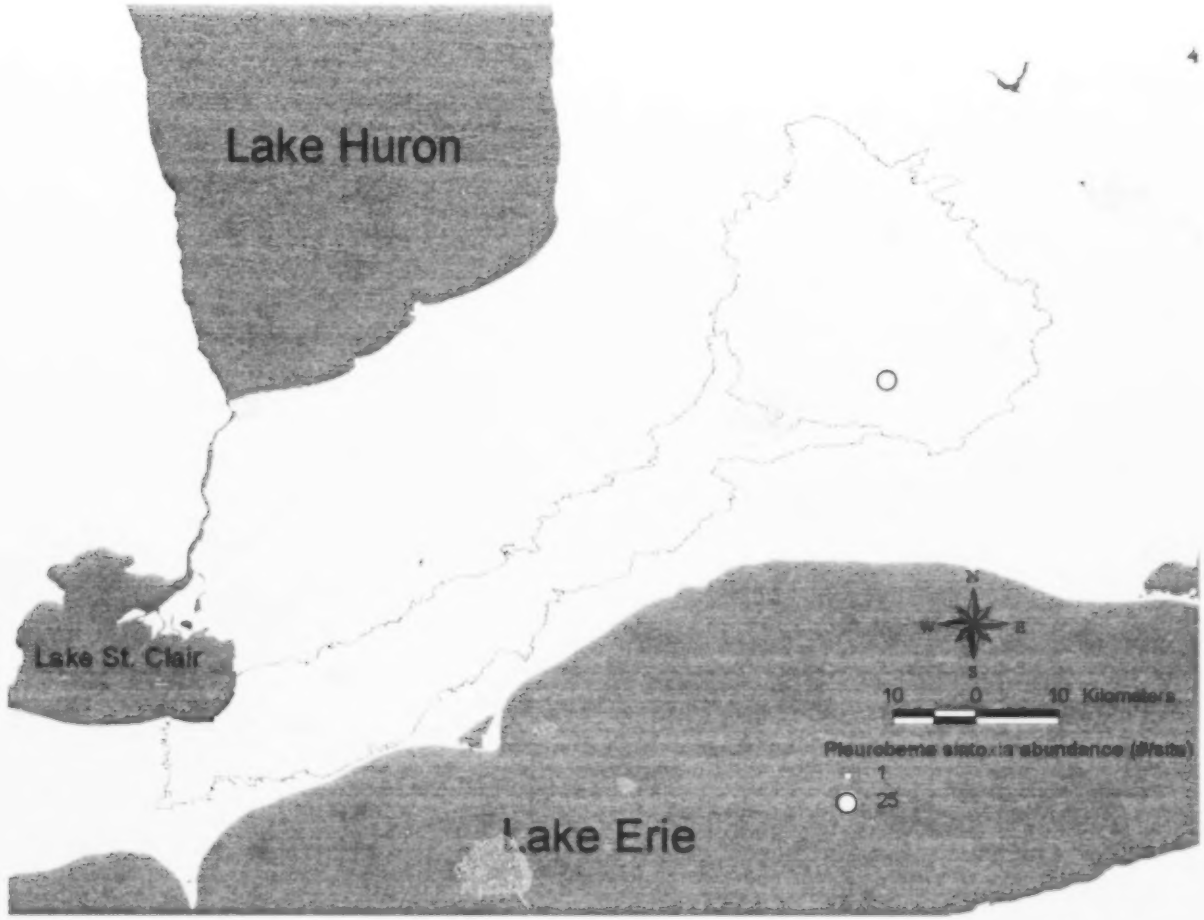

Figure 8. *Pleurobema sintoxia* abundance at 2004-2005 Thames River sites.

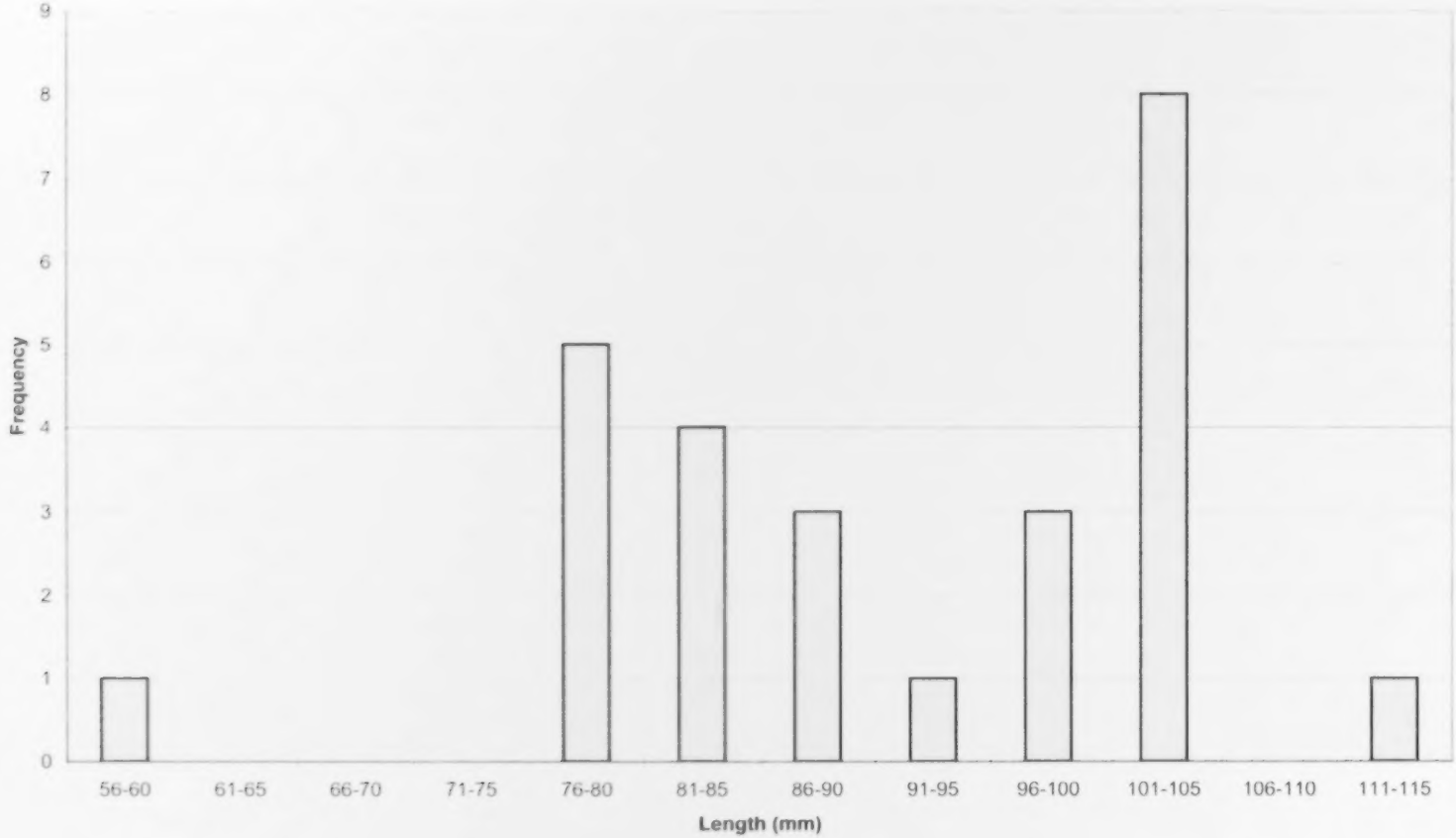

Figure 9. Size distribution of *Pleurobema sintoxia* collected from the Thames River using timed-search methods in 2004-2005.

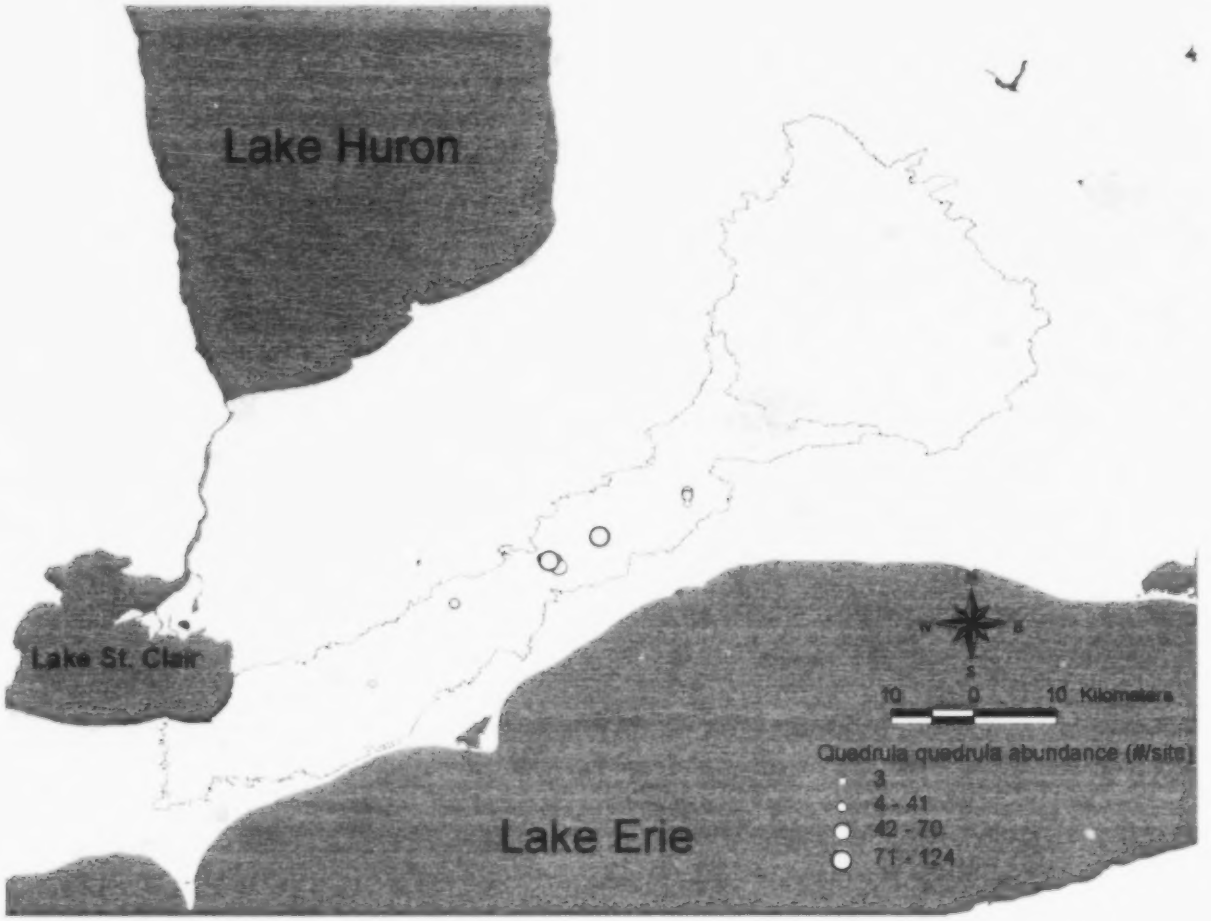

Figure 10. *Quadrula quadrula* abundance at 2004-2005 Thames River sites.

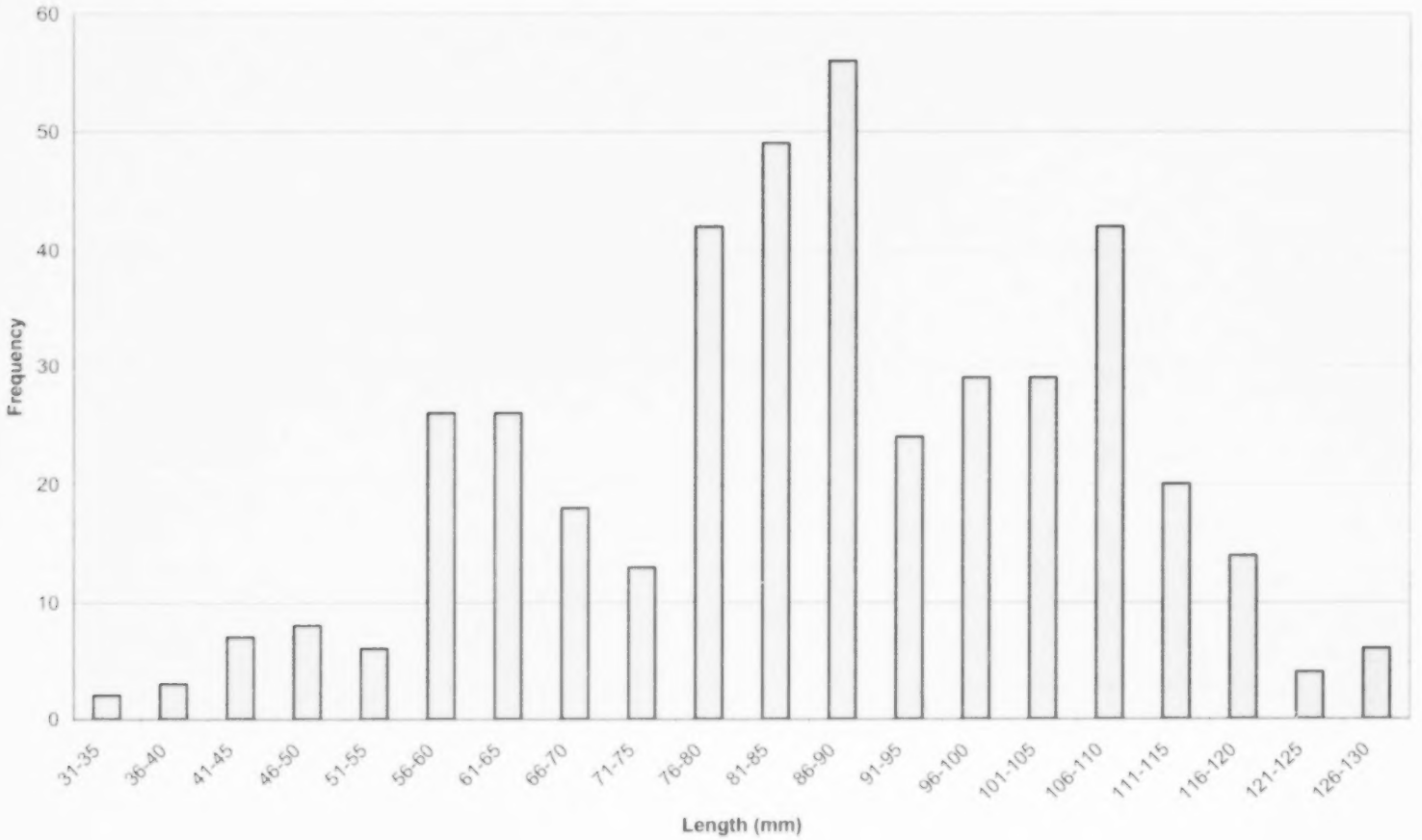

Figure 11. Size distribution of *Quadrula quadrula* collected from the Thames River using timed-search methods in 2004-2005.

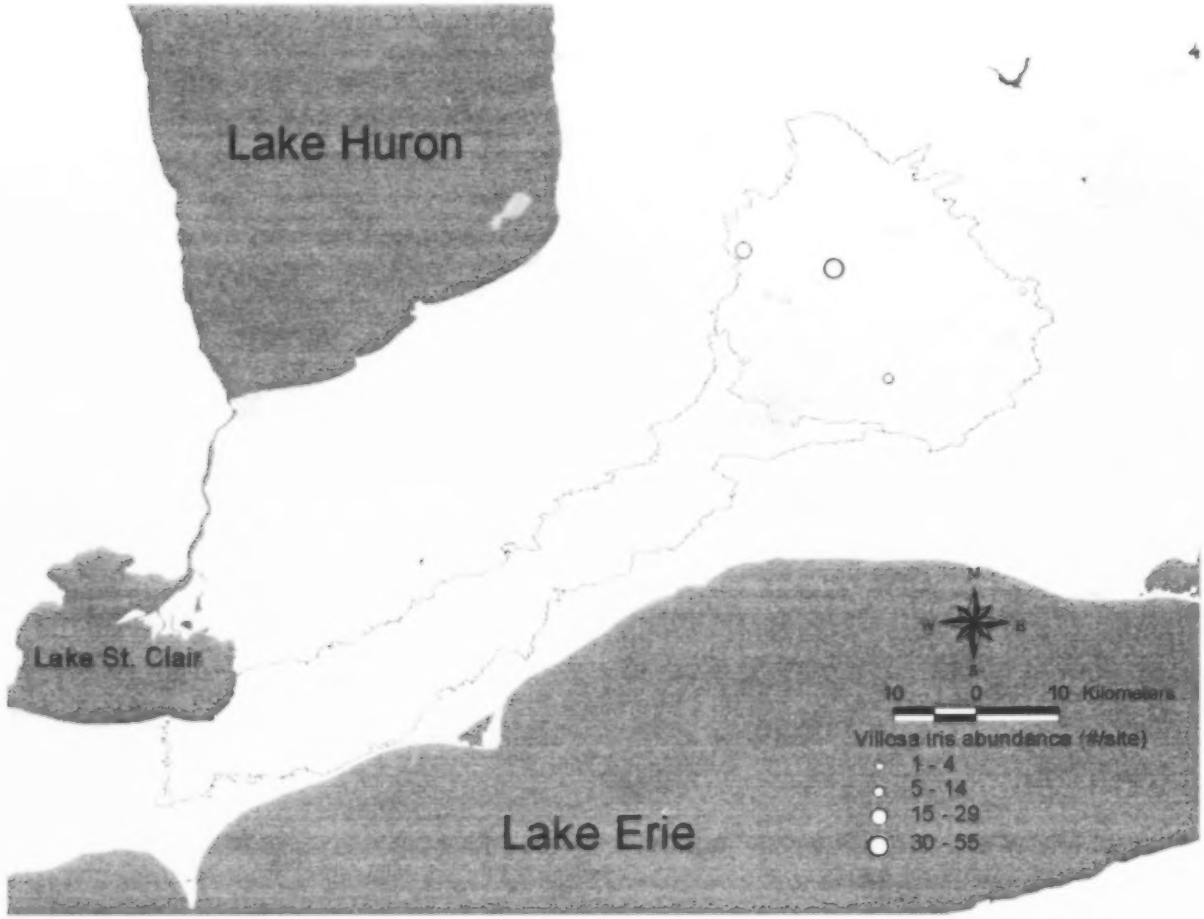

Figure 12. *Villosa iris* abundance at 2004-2005 Thames River sites.

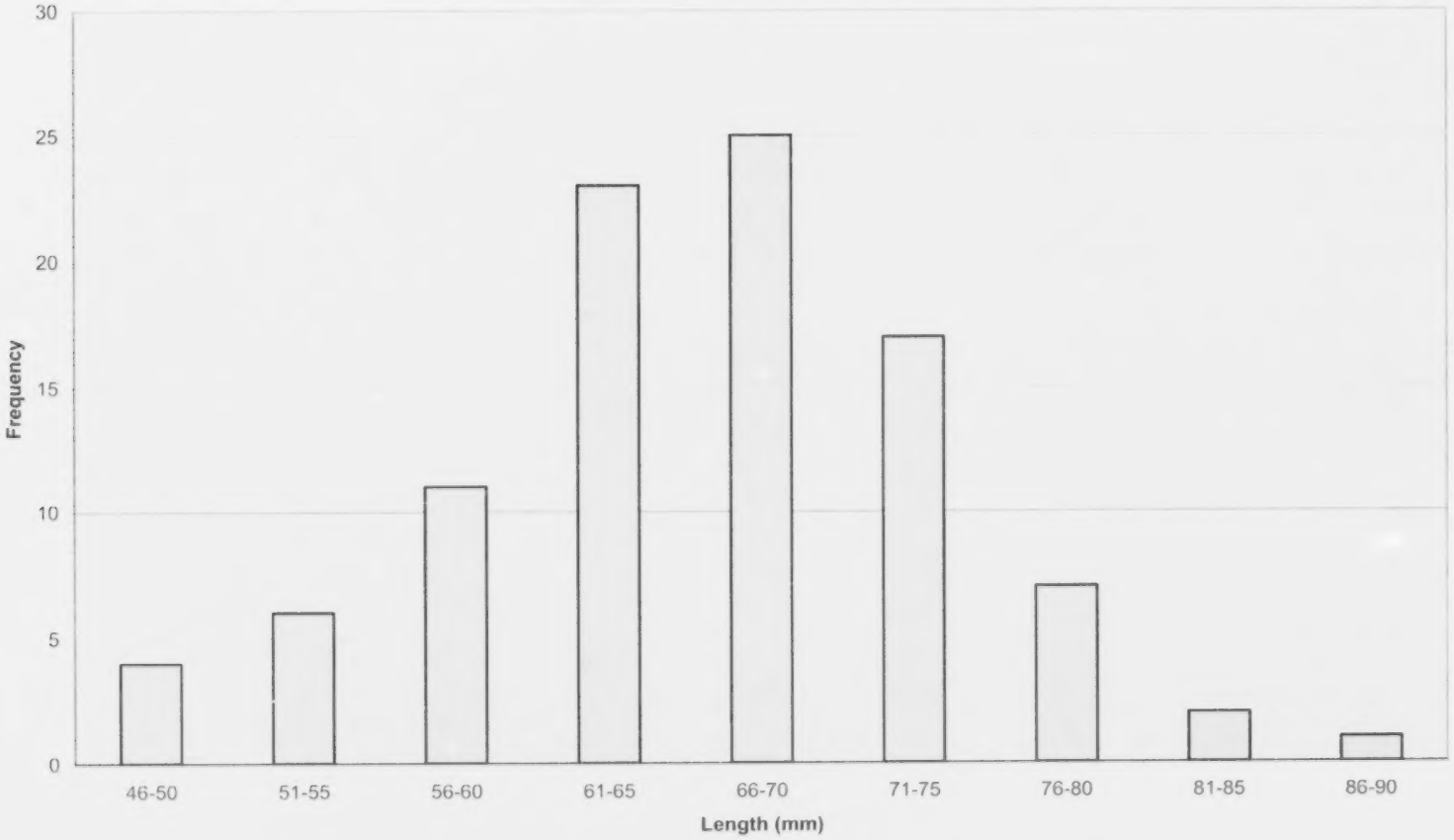

Figure 13. Size distribution of *Villosa iris* collected from the Thames River using timed-search methods in 2004-2005.

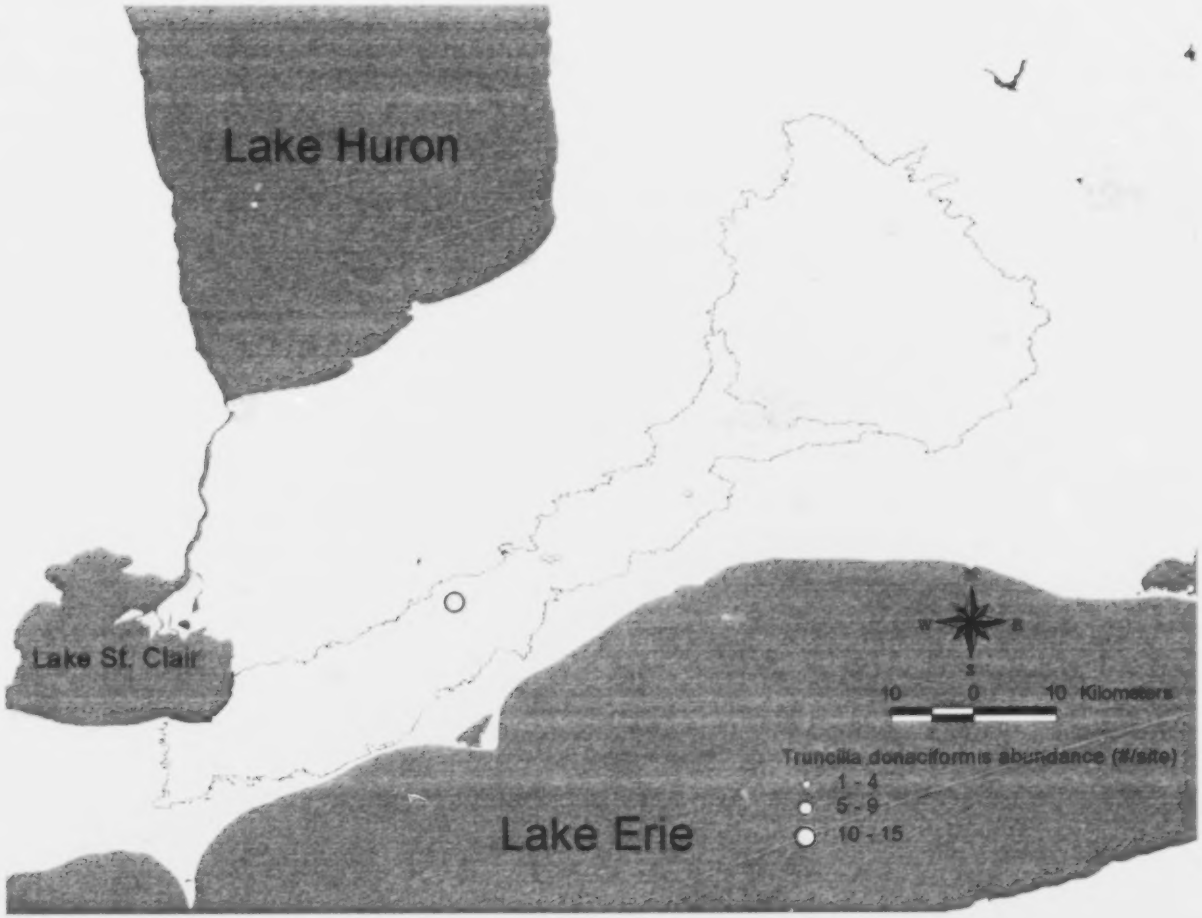

Figure 14. *Truncilla donaciformis* abundance at 2004-2005 Thames River sites.

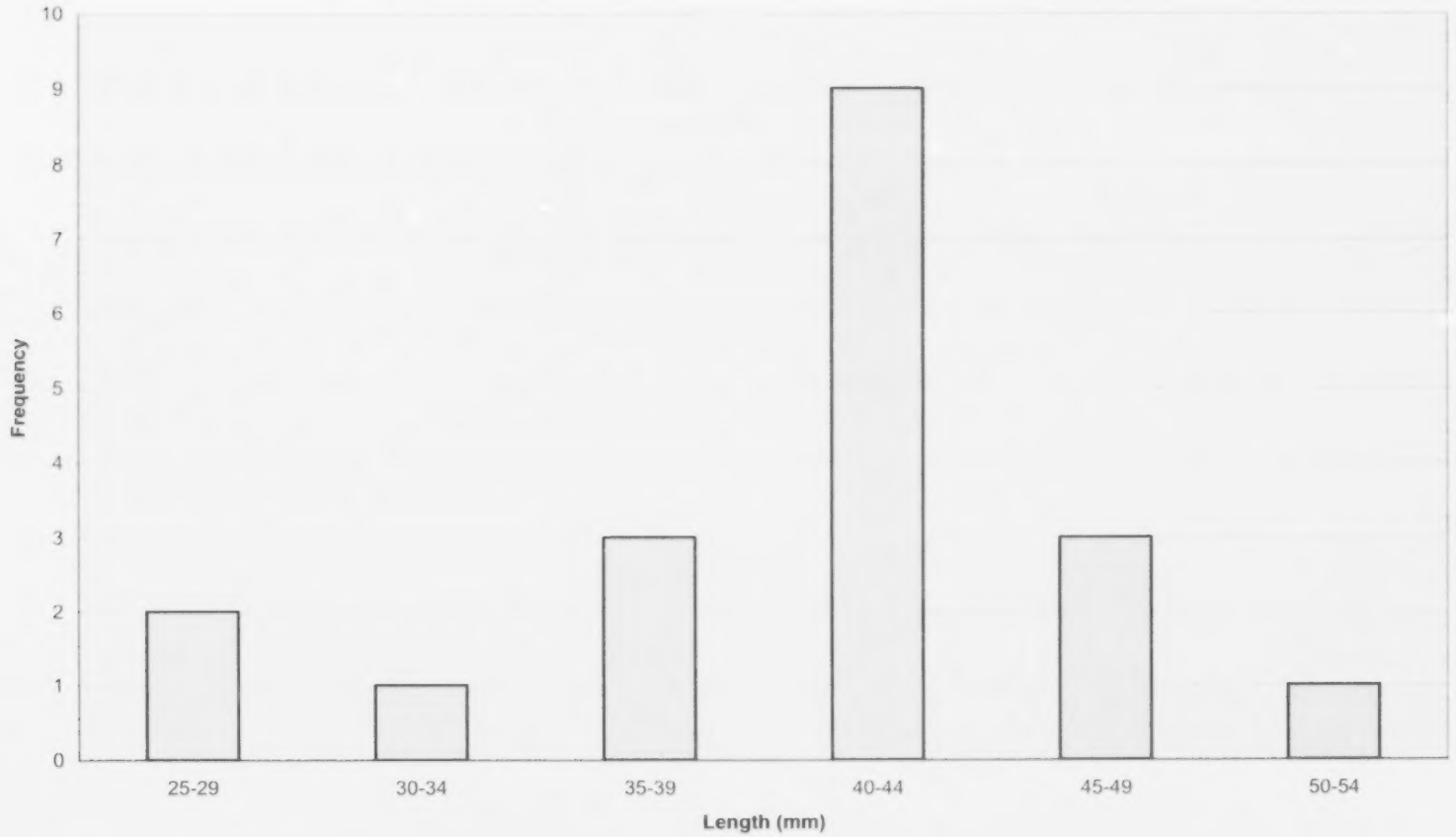

Figure 15. Size distribution of *Truncilla donaciformis* collected from the Thames River using timed-search methods in 2004-2005.